

## Juncus in Northern Patagonian Wetlands

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### INTRODUCTION

The genus *Juncus* L. (Juncaceae Juss.) contains about 315 species, distributed abundantly in both the northern and southern hemispheres, but they are rarer in the tropics (Balslev 1996; Kirschner 2002; Romero Zarco 2010). *Juncus* is currently divided into two subgenera and 10 sections (Kirschner 2002): subgenus *Juncus* (six sections) and

subgenus *Agathryon* Raf. (four sections). Although various studies on *Juncus* have been carried out in Argentina and neighbouring countries (e.g., Barros 1945, 1953, 1969; Novara 2009, 2012; Zuloaga et al. 2019; Jocou and Brignone 2020), a thorough and current review of this genus is necessary. In Argentina, the genus *Juncus* is represented by ca. 27 species and 10 infraspecific taxa (Table 1).

Subgenus	Section	Number of species in the world	Distribution	Number and species in the Argentinean Flora
<i>Agathryon</i> Raf.	<i>Forskalina</i> Kuntze	1	Distributed in the whole Mediterranean region.	not represented
	<i>Juncotypus</i> Dumort.	67	World-wide distribution. Mainly in Australia and Pacific North America.	4: <i>Juncus balticus</i> Willd. [subsp. <i>mexicanus</i> (Willd. ex Roem. & Schult.) Kirschner; subsp. <i>andicola</i> (Hook.) Snogerup]; <i>J. effusus</i> L. [subsp. <i>effusus</i> ]; <i>J. procerus</i> E.Mey.; <i>J. uruguensis</i> Griseb.
	<i>Steirochloa</i> Griseb.	35	Widespread, with species native to all temperate regions except for South Africa. Mainly in W and E North America, Central Asia and temperate South America.	7: <i>Juncus capillaceus</i> Lam.; <i>J. cordobensis</i> Barros; <i>J. dichotomus</i> Elliott; <i>J. imbricatus</i> Laharpe; <i>J. occidentalis</i> (Coville) Wiegand (incl. <i>J. tenuis</i> var. <i>congestus</i> ); <i>J. tenuis</i> Willd.; <i>J. venturianus</i> Castillón
	<i>Tenageia</i> Dumort.	11	W of Mediterranean region; some species very widespread.	2: <i>Juncus bufonius</i> L. [var. <i>bufonius</i> ]; <i>J. sorrentinii</i> Parl. (= <i>J. bufonius</i> var. <i>condensatus</i> Cout.)
<i>Juncus</i>	<i>Caespitosi</i> Cout.	16	Southern Africa, W North America.	not represented
	<i>Graminifolii</i> Engelm.	22	W North America, southern Africa, Australasian region.	2: <i>Juncus cyperoides</i> Laharpe; <i>J. marginatus</i> Rostk.
	<i>Iridifolii</i> Snogerup & Kirschner	10	W North America, Eastern Asia.	not represented
	<i>Juncus</i>	9	Not geographically circumscribed. It includes species from Europe, America, Africa and East Asia.	1: <i>Juncus acutus</i> L. [subsp. <i>leopoldii</i> (Parl.) Snogerup]
	<i>Ozophyllum</i> Dumort.	86	E North America, South America, SW Europe, the Far East, North Africa, S Africa, Oceania.	11: <i>Juncus articulatus</i> L. [subsp. <i>articulatus</i> ]; <i>J. burkartii</i> Barros; <i>J. densiflorus</i> Kunth; <i>J. diemii</i> Barros; <i>J. ernesti-barrosii</i> Barros; <i>J. llanquihuensis</i> Barros; <i>J. micranthus</i> Schrad. ex E.Mey.; <i>J. microcephalus</i> Kunth; <i>J. pallascens</i> Lam. [var. <i>pallascens</i> ; var. <i>achalensis</i> (Barros) Novara]; <i>J. scheuchzerioides</i> Gaudich.; <i>J. stipulatus</i> Nees & Meyen [var. <i>stipulatus</i> , var. <i>chilensis</i> (Gay) Kirschner]
<i>Stygiopsis</i> [Grand. ex] Kuntze	59	In high mountains of North Hemisphere and subarctic regions, centred in the Sino-Himalaya.	not represented	

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Table 1. Summary of subgenera and sections within *Juncus*, number of species in each section and their distributions worldwide, and the number and species per section in the Argentinean flora. Infraspecific rank taxa in brackets, synonyms in parenthesis.

The northern Patagonian wetlands flora contains 48 families, 137 species and 172 infraspecific taxa of vascular plants (Jocou and Gandullo 2020). In this flora, Juncaceae has the fourth most species and *Juncus* is the largest genus (Jocou and Gandullo 2020). This paper contributes to the correct identification of *Juncus* taxa which are crucial in floristic studies of wetlands in this region. Since *Juncus* is a taxonomically complicated genus and it has not been revised in Argentina, the aim of this work is to review the taxa that occur in northern Patagonian wetlands, while providing a dichotomous key, morphological and ecological information, and photographs of each taxon.

## STUDY AREA

The study wetlands are located in the northern Argentinian Patagonia, between 38° 30'S and 39° 30'S and 66° 55'W and 69° 20'W at altitudes between 190 and 380 m a.s.l. (Figure 1); they are the same wetlands studied by Jocou and Gandullo (2020). The dominant climate is cold temperate, arid to semi-arid, with average annual temperatures of 14°C, rainfall from 150–300 mm annually with a Mediterranean regime, and average annual evapotranspiration of 800 mm (Peri 2004; Gandullo and Gastiazoro 2009; Lozeco 2014; Jocou et al. 2018).

The taxa of *Juncus* occur in six environments with marked and fluctuating water conditions along the year (for a detailed description see Jocou and Gandullo 2020):

1. *Maturana lagoon* (Figure 2A, B) – an artificial lagoon located in the city of Senillosa (province of Neuquén) a few meters from National Route 22 (39°00'41''S and 68°26'20''W).
2. *Ezequiel Ramos Mexía dam* (Figure 2C, D) - an artificial lake located on the boundaries of Río Negro and Neuquén provinces (39°30'S and 69°00'W).
3. *Balsa Las Perlas lagoon* (Figure 2E, F) – a small natural riparian lagoon, located at 60 m from the shore of the Limay River (38°58'47''S and 68°7'23''W).
4. *Drainage canals* (Figure 3A–C) – an extensive network of artificial canals (more than 500 km) that collect excess water for irrigation, infiltration and rain, as well as urban and industrial waste; they are located throughout the valleys.
5. *Irrigation canals* (Figure 3D–F) – an extensive network of artificial canals (more than 2000 km) that divert the watercourse of the rivers; they are used for the irrigation of fruit and vegetable production in the valleys of the Limay, Neuquén and Negro Rivers.

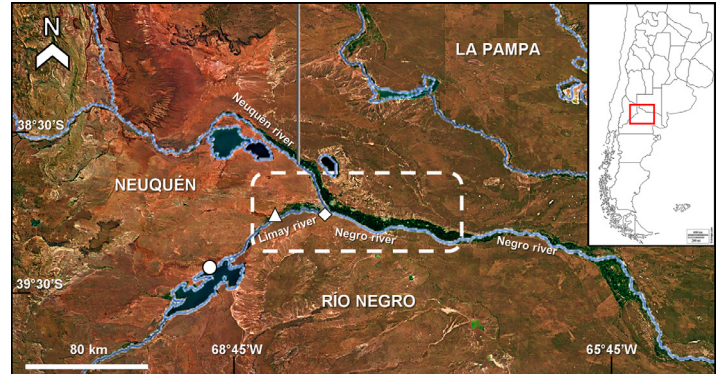


Figure 1. Study area, location of the surveyed wetlands. Diamond indicates the natural riparian lagoon Balsa Las Perlas, triangle indicates Maturana lagoon, circle indicates Ezequiel Ramos Mexía dam. Dashed line indicates study area of rivers, and irrigation and drainage canals. (Source: Satellite layer, from Google Earth ®)

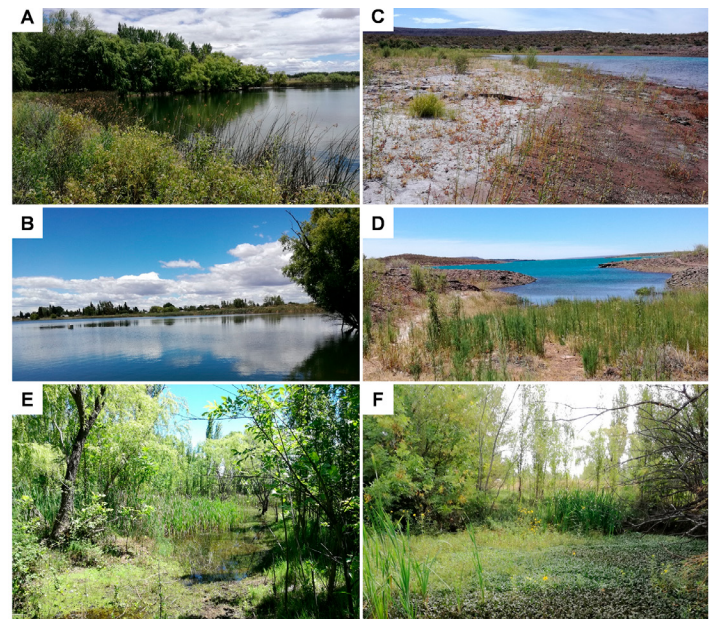


Figure 2. Environments inhabited by taxa of *Juncus*. A, B. Maturana lagoon. C, D. Ezequiel Ramos Mexía dam. E, F. Balsa Las Perlas lagoon. (Photographs: A.I. Jocou)

6. *Rivers* - Limay, Negro and Neuquén- (Figure 3G, H). The Negro River Basin is among the most important hydrographic systems in Argentina; it is the main source of water for fruit production in the lower valleys of the Neuquén and Limay Rivers, and the upper valley of the Negro River. The water level varies during the year depending on the use of hydroelectric dams, irrigation, and seasonal climatic conditions in the upper basin.

## MATERIALS AND METHODS

Previous works on the genus *Juncus* were consulted (Barros 1945; 1953; 1969; Balslev 1996; Kirschner 2002; Novara 2009; Romero Zarco 2010; Novara 2012; Balslev and Duno de Stefano 2015; Balslev 2018; Zuloaga et al. 2019;



Jocou and Brignone 2020). We created a list of taxa of *Juncus* from our ongoing ecological and floristic studies in the wetlands of Patagonia in Argentina (e.g., Fernández et al. 2018; Jocou et al. 2018; Gandullo et al. 2019; Jocou and Gandullo 2020; Jocou and Brignone 2020). We reviewed the Argentinean specimens of *Juncus* kept at the ARC (herbarium acronyms following Thiers 2021) and confirmed their identity using classical methods in taxonomy.

The morphological study of the specimens was performed under a stereo-microscope Leica EZ4 HD, and the photographs were taken using LAS EZ 3.4.0.

### RESULTS AND DISCUSSION

For each name, the earliest published name or basonym (indicated as  $\equiv$ ) and its type specimens are provided. The heterotypic synonyms are indicated as = symbol. The exclamation mark after citing a type specimen indicates that the specimen was seen on a scanned image. The examined specimens cited are kept at ARC; those cited as *Specimens of reference* are from northern Patagonian wetlands, whereas *Additional examined specimens* include those from other areas from Patagonia in Argentina. The water characteristics of wetlands where the studied taxa of *Juncus* were found are shown in Table 2.

The taxa from the northern Patagonian wetlands can be distinguished using the following dichotomous key. For precise identification, the specimens must have both vegetative (rhizomes, stem, leaves) and reproductive structures (flowers, fruits). We recommend taking detailed field photographs and preparing dry specimens to be kept in herbaria for further studies.



Figure 3. Environments inhabited by taxa of *Juncus*. A-C. Drainage canals, distinct wet conditions and dimensions. D-F. Irrigation canals, distinct dimensions: primary (F), secondary (E), and tertiary (D) canals. G, H. Shores of Limay River. (Photographs: A.I. Jocou)

Taxon	Water characteristics		
	pH	EC ( $\mu\text{S/cm}$ )	DO (mg/L)
<i>J. acutus</i> subsp. leopoldii	7.7–8.4	230–250	5.9–7.9
<i>J. articulatus</i> subsp. articulatus	7.2–9	70–280	8–10
<i>J. balticus</i> subsp. andicola	5.8–8.6	187–1620	0.4–12
<i>J. balticus</i> subsp. mexicanus	5.8–8.6	187–1620	0.4–12
<i>J. bufonius</i> var. bufonius	7.2–8	70–180	9–10
<i>J. effusus</i> subsp. effusus	6–7.7	79–254	3.8–9.2
<i>J. microcephalus</i>	5.8–9	70–1620	0.4–12
<i>J. pallescens</i> var. pallescens	6–9	70–280	3.8–10
<i>J. tenuis</i>	7.2–8	70–80	9–10

Table 2. Water characteristics of wetlands inhabited by taxa of *Juncus*. EC: electrical conductivity, DO: dissolved oxygen.

**KEY OF THE TAXA OF *JUNCUS* PRESENT IN NORTHERN PATAGONIAN WETLANDS**

1. Inflorescence racemose, flowers without a pair of bracteoles below; flowers usually in heads or clusters, rarely borne singly or in loose groups	2
1 <sup>?</sup> . Inflorescence cymose, flowers with a pair of bracteoles below; flowers usually borne singly or in loose groups	5
2. Leaves stem-like, pungent, not septate; lower bract apparently forming a prolongation of stem	<i>J. acutus</i> subsp. <i>leopoldii</i>
2 <sup>?</sup> . Leaves not stem-like, perfectly septate; lower bract not appearing as a stem prolongation	3
3. Capsule exceeding the perianth	<i>J. articulatus</i> subsp. <i>articulatus</i>
3 <sup>?</sup> . Capsule shorter than the perianth	4
4. Tepals rigid and castaneous to dark castaneous; flower head peduncles usually 0.45 mm thick or thicker.	<i>J. pallescens</i> subsp. <i>pallescens</i>
4 <sup>?</sup> . Tepals soft and stramineous-castaneous to castaneous; flower head peduncles usually 0.4 mm thick or thinner.	<i>J. microcephalus</i>
5. Annuals	<i>J. bufonius</i> var. <i>bufonius</i>
5 <sup>?</sup> . Perennials	6
6. Inflorescence obviously terminal, lower bract flat, not appearing as a prolongation of the stem; basal leaves with a blade, and flat (grass-like)	<i>J. tenuis</i>
6 <sup>?</sup> . Inflorescence seemingly lateral (pseudo-lateral); lower inflorescence bract terete, erect, apparently forming a prolongation of the stem; basal leaves usually bladeless, if bladed then terete or ± compressed and twisted, but never completely flat	7
7. Densely caespitose plants; rhizome very short-noded; tepals 2–3 mm long, acute to acuminate, green to light brown	<i>J. effusus</i> subsp. <i>effusus</i>
7 <sup>?</sup> . Not caespitose plants; rhizome sparsely branching with mostly 5–10 mm long nodes. Tepals 3–5 mm long, obtuse to apiculate, light to dark brown	8
8. Stem usually 3–10 mm diam., not compressed or twisted; cataphylls with an awn-like blade, but never with well-developed blade	<i>J. balticus</i> subsp. <i>andicola</i>
8 <sup>?</sup> . Stem 1–3 mm diam., usually compressed and twisted; 1–2 uppermost cataphylls with a well-developed blade	<i>J. balticus</i> subsp. <i>mexicanus</i>



## PROFILES OF THE TAXA

**1. *Juncus acutus* L. subsp. *leopoldii* (Parl.) Snogerup, *Bot. Not.* 131: 187. 1978. ≡ *Juncus leopoldii* Parl., *Giorn. Bot. Ital.* 2: 324-325. 1846.**

*TYPE* (lectotype designated by Snogerup, *Willdenowia* 23: 37. 1993): South Africa, Sommerset, Stellenbosch, *Ecklon & Zeyer 4308* (FI! barcode 000909; isolectotypes S! barcode S-G-008001, W! barcode 0015534).

*Brief description.* It is a densely caespitose plant with basal, very pungent leaves. Inner tepals mucronate, with two auricles. Stamens 6, anthers 2.5–4 times as long as filaments. Mature capsules brown to dark brown, rounded and exceeding the perianth. (Figure 4A–D).

*Ecology and occurrence.* Worldwide this subspecies inhabits coastal sandy, salt marshes and inland moist saline or marshy habitats, and alkaline seeps, sometimes growing in places with a carbonate crust and sulphurous salts and in areas with groundwater; from sea level to 1500 m (Snogerup 1993; Balslev 1996; Brooks and Clemants 2000; Kirschner 2002; Romero Zarco 2010; Balslev and Duno de Stefano 2015). Novara (2012) considered this taxon as a halophytic indicator of very saline soils. In the northern Patagonian wetlands, this taxon grows on the shores of the Maturana lagoon at ca. 290 m a.s.l. The water is classified as alkaline, slightly saline and moderately to well-oxygenated (Table 2). The soils where it grows are sandy to sandy-clay.

*Specimen of reference.* Prov. Neuquén: Senillosa, Laguna Maturana, 20-XII-2018, *Jocou, Minué & Gandullo 2242* (ARC).

**2. *Juncus articulatus* L., *Sp. Pl.* 1: 327. 1753. subsp. *articulatus*.**

*TYPE* (lectotype designated by Ferrer-Gallego, *Taxon* 68: 145. 2019): Herb. A. van Royen, (L! barcode 0221767).

*Brief description.* Densely to loosely densely caespitose plants with perfectly septate leaves. Tepals maroon or straw-coloured, completely brown or with a green central band, ovate to lanceolate. Stamens 6, anthers usually equaling filaments. Mature capsules castaneous to dark brown, trigonous to ovoid, and exceeding the perianth. (Figure 4E–I).

*Ecology and occurrence.* Worldwide, this subspecies inhabits various moist and wet natural or man-made places, margins of watercourses, usually on acid soils, often behaving like a calcicole, from sea level to 3700 m (Grime et al. 1988; Brooks and Clemants 2000; Guofang and Clemants 2000; Kirschner 2002; Romero Zarco 2010; Ferrer-Gallego

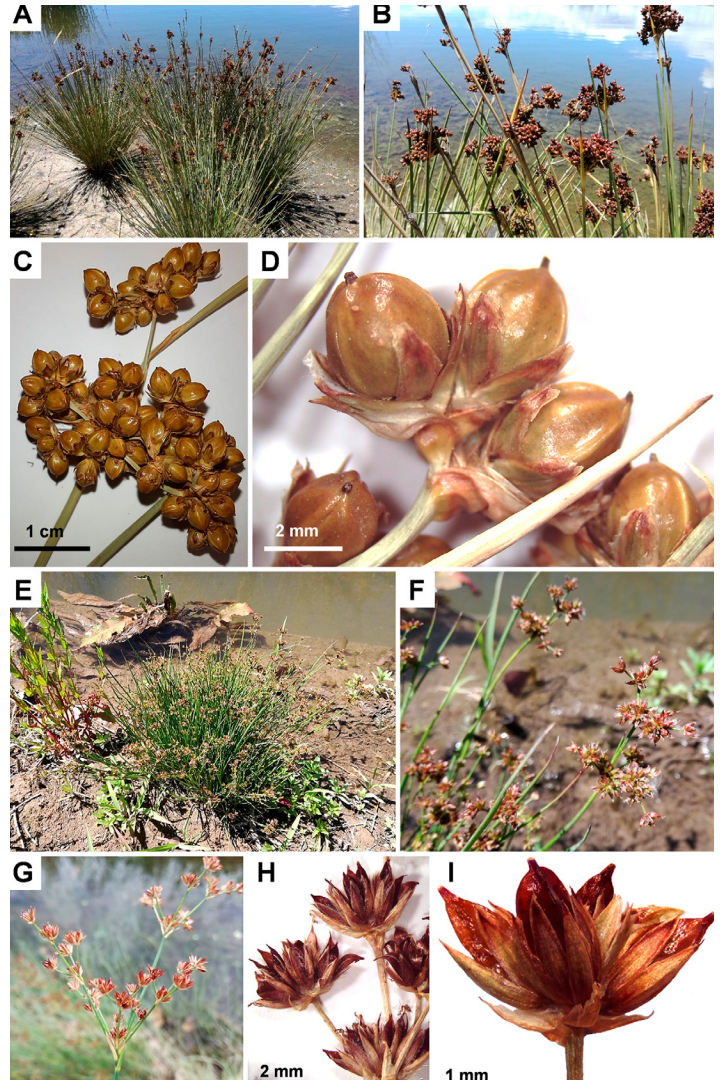


Figure 4. *Juncus acutus* subsp. *leopoldii*: A. Habit, Maturana lagoon. B. Close-up of inflorescences, in vivo. C. Fruits, dry specimen. D. Close-up of perianth with capsule, dry specimen. *Juncus articulatus* subsp. *articulatus*: E. Habit, irrigation canal. F–G. Variation of inflorescence, in vivo. H. Close-up of inflorescence, dry specimen. I. Close-up of a head, dry specimen. (Photographs: A.I. Jocou)

2019; Jocou and Brignone 2020). In the northern Patagonian wetlands, this taxon grows on the shores of Neuquén and Limay Rivers, and in irrigation canals, from 250–290 m a.s.l. The water is near-neutral to alkaline, sparingly to moderate saline, and oxygen-saturated (Table 2). The soils where it grows are mainly sandy.

*Specimens of reference.* Prov. Neuquén: Centenario, Balneario municipal, 29-XII-2016, *Jocou & Minué 2313* (ARC); Neuquén, Balsa Las Perlas, 17-XI-2018, *Jocou, Minué & Gandullo 2117* (ARC). Prov. Río Negro: Allen, 12-XII-2018, *Jocou et al. 2314* (ARC); Cinco Saltos, 3-II-2020, *Jocou 2318* (ARC); Cipolletti, 12-XII-2018, *Jocou et al. 2315* (ARC); General Fernández Oro, 9-I-2020, *Jocou*



2316 (ARC); General Fernández Oro, 9-I-2020, *Jocou* 2317 (ARC).

**3. *Juncus balticus*** Willd., *Mag. Neuesten Entdeck. Gesammten Naturk. Ges. Naturf. Freunde Berlin* 3: 298. 1809.

Worldwide this species has seven geographically and morphologically recognized subspecies (Kirschner 2002). However, the taxonomy of *J. balticus* in South America remains unexplored (Kirschner 2002). In the northern Patagonian wetlands, two subspecies are recognized up to date.

**3a. subsp. *andicola*** (Hook.) Snogerup, *Preslia* 74: 258. 2002. ≡ *Juncus andicola* Hook., *Hooker's Icon. Pl.*, ser. 2, 8: t. 714. 1848.

*TYPE* (holotype): Ecuador, Andes of Quito, *W. Jameson* 51 (K! barcode 000574359, isotypes BM, not seen; G! barcode 00098687, 00098686).

*Brief description.* Plants up to 110 cm tall, usually robust, not caespitose, forming large and often dense stands. Stems 3–10 mm thick, terete, not compressed (rarely twisted). Cataphylls bladeless. Inflorescence much-branched, bracteoles light to reddish-brown. Tepals castaneous to dark castaneous, with central band green to light brown. Stamens 6, anthers 1.5–2 times as long as filaments. Capsule ellipsoid-ovoid, trigonous, light brown, shorter than or equalling perianth, acuminate. (Figure 5A–D).

*Ecology and occurrence.* This subspecies inhabits wet pastures in the mountains, margins of lakes, rivers, lagoons, ponds, and forest, gravelly banks of streams, often in cattle fields and other places under human influence; up to 4000 m a.s.l. (Balslev 1996; Kirschner 2002; Balslev and Duno de Stefano 2015). In the northern Patagonian wetlands, this taxon grows on drainage canals and shores of Maturana and Balsa Las Perlas lagoons, and rivers. The water is near-neutral to alkaline, slightly to highly saline and hypoxic to oxygen-saturated (Table 2). The soils where this taxon grows are mainly sandy, occasionally sandy-clay to clay.

*Specimens of reference.* Neuquén, Senillosa, Laguna Maturana, 20-XII-2018, *Jocou, Gandullo & Minué* 2243 (ARC); Neuquén, Laguna Río Limay, Balsa Las Perlas, 17-XI-2018, *Jocou, Minué & Gandullo* 2115 (ARC); Río Limay, 17-XI-2018, *Jocou, Minué & Gandullo* 2118 (ARC).

*Additional examined specimens.* Prov. Neuquén: Camino El Huecú – El Cholar, s.d., *Pérez s.n.* (ARC); ANP Domuyo, Vega Los Menucos camino C° Las Papas, 01-III-2005, *Gandullo GR563* (ARC). Prov. Río Negro: s.d., “Mallín 2”, 19-I-1983, *Ojeda s.n.* (ARC).

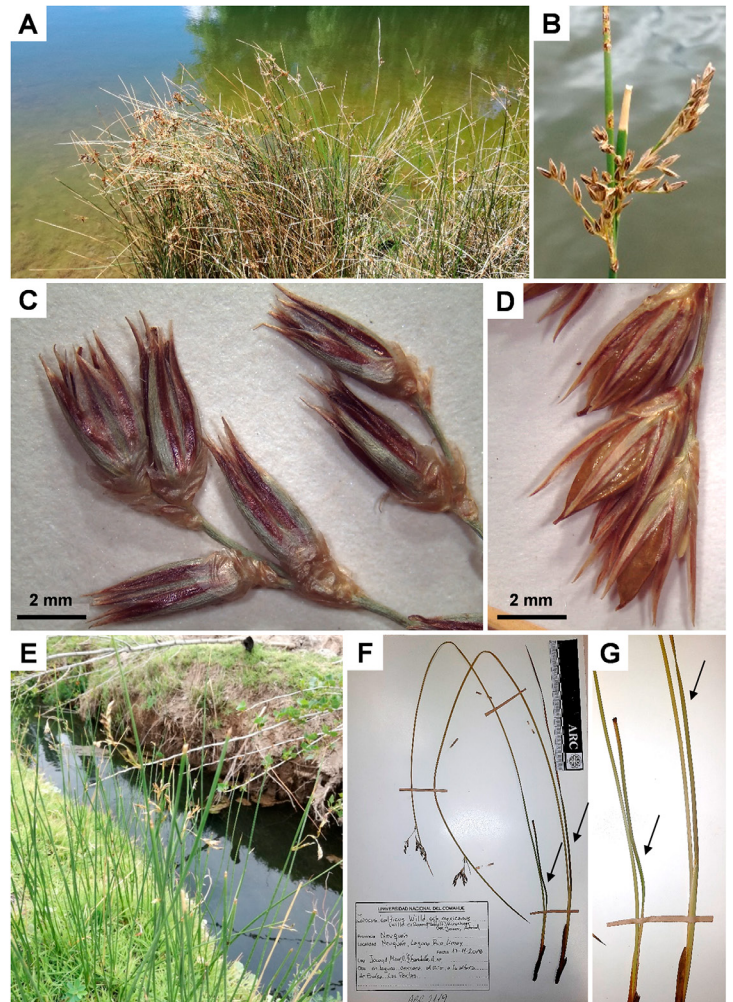


Figure 5. *Juncus balticus* subsp. *andicola*: A. Habit, Maturana lagoon. B. Close-up of inflorescence, Limay River. C. Close-up of flowers. D. Close-up of perianth with capsule. *Juncus balticus* subsp. *mexicanus*: E. Habit, drainage canal. F. Herbarium sheet, arrows indicate the uppermost cataphyll with well-developed blade. G. Close-up of uppermost cataphyll. (Photographs: A.I. Jocou)

**3b. subsp. *mexicanus*** (Willd. ex Roem. & Schult.) Snogerup, *Preslia* 74: 257. 2002. ≡ *Juncus mexicanus* Willd. ex Roem. & Schult., *Syst. Veg., ed. 15 bis [Roemer & Schultes]* 7(1): 178. 1829.

*TYPE* (holotype): Mexico, *Humboldt & Bonpland s.n.* (B! barcode B -W 06843 -01 0, isotypes P barcode 00738780, not seen).

*Brief description.* Plants up to 70 cm tall, not caespitose, forming loose to dense stands. Uppermost 1–2 cataphylls with well-developed blades. Stems usually up to 3 mm thick. Inflorescence diffuse or with several loose clusters on short, usually flexuose peduncles, bracteoles pale stramineous, sometimes pale castaneous-brown at the base. Tepals are not much different from those found in subsp. *andicola*. Stamens 6, anthers much longer than filaments. Capsule

more or less equalling perianth, narrowly oblong-ovoid, subtrigonus, abruptly contracted, castaneous-brown to brown. (Figure 5E–G).

**Ecology and occurrence.** This taxon inhabits open soils and sunny places, wet meadows, swamps, streams and ponds, often on sandy and more or less saline soils; it can be weedy and found on road banks, grazing areas, cropped areas, and even in crevices; from sea level to 4000 m a.s.l. (Kirschner 2002; Balslev and Duno de Stefano 2015). In the northern Patagonian wetlands, this taxon grows on the shores of the natural riparian lagoon Balsa Las Perlas, and along drainage canals. The water is near-neutral to alkaline, slightly to highly saline and hypoxic to oxygen-saturated (Table 2). The soils where this taxon grows are mainly sandy, occasionally sandy-clay to clay. After *J. tenuis*, this subspecies is the second most common taxon on drier soils in the studied wetlands.

**Specimen of reference.** Prov. Neuquén: Neuquén, Laguna Río Limay, Balsa Las Perlas, 17-XI-2018, *Jocou, Minué & Gandullo 2119* (ARC).

#### 4. *Juncus bufonius* L., Sp. Pl. 1: 328. 1753. var. *bufonius*.

**TYPE** (lectotype designated by Cope & Stace, *Watsonia* 12: 121. 1978): Herb. A. van Royen, (L! barcode 0052756).

**Brief description.** Small annual caespitose plants, usually up to 25 cm tall. Inflorescence constitutes most of the plant height, lax, open, bracteoles hyaline, scarious. Tepals broadly lanceolate with greenish central band and broad membranous margins. Stamen usually 6, anthers usually as long as filaments. Capsule narrowly ovoid to subellipsoid, shorter than perianth, acute to subacute. (Figure 6A–D).

**Taxonomic remarks.** *Juncus bufonius* is part of a complex of very similar and closely related taxa (Balslev 1996; Brooks and Clemants 2000; Kirschner 2002; Romero Zarco 2010). It is an extremely variable species in general habit as a result of a variety of habitats (Kirschner 2002) which led to the publication of numerous names of infraspecific level (see Barros 1953; Cope and Stace 1978; Balslev 1996; Brooks and Clemants 2000; Kirschner 2002). The specimens collected in northern Patagonian wetlands are treated here as var. *bufonius*, according to regional literature (see Zuloaga et al. 2019).

**Ecology and occurrence.** This cosmopolitan taxon most frequently inhabits open muddy flats, denuded bottoms of ponds and periodic ponds, moist soils in meadows, lakeshores or stream banks, ditches, roadsides, drawdown areas, wet tracks, wet fields, swamps, and other tempo-

rory wet habitats with suppressed competition, behaviour as weedy species; from 0–2900 m a.s.l. (Balslev 1996; Brooks and Clemants 2000; Guofang and Clemants 2000; Kirschner 2002; Balslev and Duno de Stefano 2015). In the northern Patagonian wetlands, this taxon inhabits the shores of Limay and Negro Rivers. The water is near-neutral to alkaline, sparingly saline and saturated with oxygen (Table 2). The soils where this taxon grows are mainly sandy.

**Specimens of reference.** Prov. Neuquén: Neuquén, Balsa Las Perlas, 17-XI-2018, *Jocou, Minué & Gandullo 2116* (ARC). Prov. Río Negro: General Fernández Oro, 12-XII-2018, *Jocou & Gandullo 2203* (ARC).

**Additional examined specimens.** Prov. Neuquén, Caviahue, 10-III-1980, *Conticello 156* (ARC). Prov. Río Negro: s.d., 19-I-1983, *Ojeda 73* (ARC).

#### 5. *Juncus effusus* L., Sp. Pl. 1: 326. 1753. subsp. *effusus*.

**TYPE** (lectotype designated by Lye, in Edwards, Sebsebe and Hedberg, *Fl. Ethiop. Eritr.* 6: 387. 1997): Herb. Linn. (LINN! barcode 449.6).

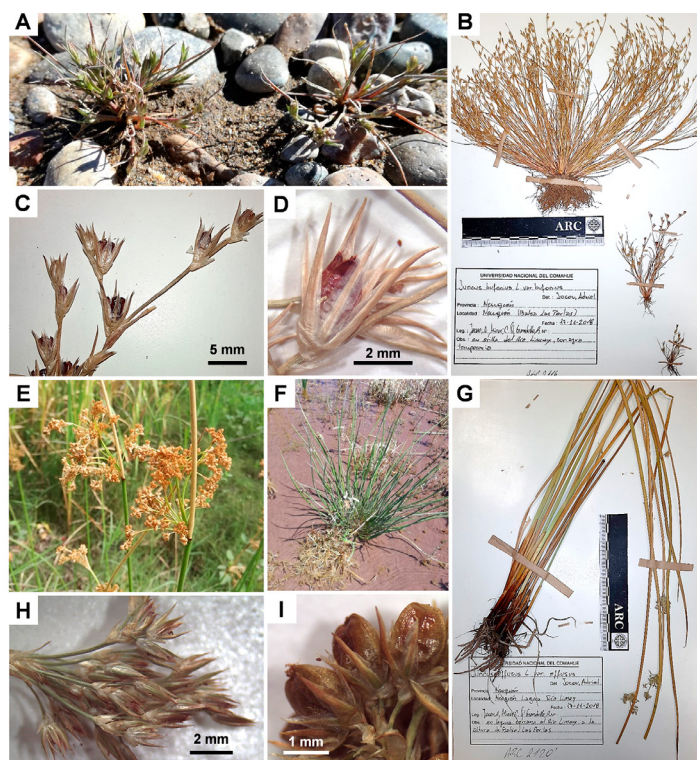


Figure 6. *Juncus bufonius* var. *bufonius*: A. Habit, shores of Limay River. B. Herbarium sheet, size variation of specimens. C. Close-up of inflorescence, dry specimen. D. Close-up of perianth with capsule, dry specimen. *Juncus effusus* subsp. *effusus*: E. Inflorescence, Balsa Las Perlas lagoon. F. Habit, E.R. Mexía dam. G. Herbarium sheet. H. Close-up of inflorescence, dry specimen. I. Close-up of perianth with capsule, dry specimen. (Photographs: A.I. Jocou)



**Brief description.** Densely caespitose perennial plants, up to 100 cm tall. Inflorescence pseudolateral, many-flowered dense to moderately lax, bracteoles often unequal, ovate, acute. Flowers small, 2–3 mm long, tepals green to light brown, with scarious margin, lanceolate, acute to acuminate, thin and soft, central band greenish to stramineous-brown. Stamens usually 3, anthers equalling the filaments. Capsule trigonous-ovoid, obtuse, light brown, subequal to or slightly exceeding perianth. (Figure 6E–I).

**Ecology and occurrence.** This taxon inhabits a wide range of wet sites from meadows and pastures, ditches, ponds, puddles in full sun, shores of bodies of water near roads, shores to mountain tracks and other places under the human influence (Balslev 1996; Kirschner 2002; Balslev and Duno de Stefano 2015). In the northern Patagonian wetlands, this taxon inhabits the shores of Ezequiel Ramos Mexía dam and the riparian lagoon Balsa Las Perlas. The water is near-neutral to alkaline, slightly to moderately saline and poorly oxygenated to saturated with oxygen water (Table 2).

**Specimens of reference.** Prov. Neuquén: Embalse E.R. Mexía, 10 km de Villa Chocón, 06-I-2019, *Jocou & Minué 2240* (ARC); Neuquén, Laguna Río Limay, Balsa Las perlas, 17-XI-2018, *Jocou, Minué & Gandullo 2120* (ARC).

**6. *Juncus microcephalus*** Kunth., *Nov. Gen. Sp. [H.B.K.]* 1: 237. 1816

**TYPE** (holotype): Colombia, Quindío, *Humboldt & Bonpland s.n.* (P! barcode 00135241; isotypes A! (ex GH) barcode 00029703, B! barcode B-W 06860-01 0).

=*Juncus involucratus* Steud ex. Buchenau, *Abh. Naturwiss. Vereins Bremen* 4: 121. 1874.

**TYPE** (lectotype designated by Balslev, *Fl. Neotrop. Monogr.* 68: 106. 1996): Peru, Tabina, Jul. 1854, *Lechler 2078* (GOET! barcode 004188; isolectotypes K! barcode 000574353, MO! barcode 104757, S! barcode S-R-3087, O! barcode O-V-2014452, AAU, not seen).

**Brief description.** Caespitose plants, up to 100 cm tall. Inflorescence anthelate, of 7–50 conical to globose, 10–35-flowered heads, each head 5–10 mm wide; heads often agglomerated. Tepals soft, stramineous to castaneous. Stamens 6, anthers shorter than filaments. Capsule ellipsoid to obovoid, obtuse, subequalling perianth, stramineous-brown to blackish; valves inflexed at the apex. (Figure 7A–D).

**Taxonomic remarks.** This species is extremely variable and closely related to *Juncus pallescens*. Although Zuloaga et al. (2019) treated *J. involucratus* as separated species, we

treat it here as a heterotypic synonym of *J. microcephalus*, according to Balslev (1996) and Kirschner (2002). Some specimens collected in the northern Patagonian wetlands have agglomerated heads, similar to the type specimens of *J. involucratus*.

**Ecology and occurrence.** This species inhabits wet highland sites and swampy places, along streams, ditches, canal banks, ponds, streams, creek bottoms (Kirschner 2002; Balslev and Duno de Stefano 2015). In the northern Patagonian wetlands, this taxon inhabits the shores of rivers and grows in drainage and irrigation canals. The water is near-neutral to alkaline, sparsely to highly saline and hypoxic to saturated with oxygen (Table 2). The soils where this taxon grows range from sandy to clay.

**Specimens of reference.** Prov. Neuquén: Plottier, 19-I-2018, *Jocou & Gandullo 2114* (ARC). Prov. Río Negro: General Fernández Oro, 09-I-2020, *Jocou 2384* (ARC); Cipolletti, 14-IX-2016, *Jocou, Fernández & Gandullo 2385* (ARC).

**7. *Juncus pallescens*** Lam., *Encycl.* 3: 268. 1789. var. *pallescens*.

**TYPE** (holotype): Argentina, buenos Aires, 1767, *P. Comerson s.n.* (P! barcode 00744272, isotype P?, not seen).

=*Juncus dombeyanus* J.Gay ex Laharpe, *Mém. Soc. Hist. Nat. Paris* 3: 132. 1827.

**TYPE** (holotype, *sensu* Balslev 1996): Peru, *Dombey s.n.* (P! barcode 00135244; isotypes P! barcodes 00135245, 00744275, 00744277, 00744278).

**Brief description.** Caespitose, up to 60 cm tall. Inflorescence anthelate, of 3–25 semiglobose to globose, 8–20-flowered heads, each head 5–10 mm wide. Tepals rigid, castaneous to dark castaneous. Stamen usually 6, anthers shorter to equalling perianth. Capsule ellipsoid to obovoid, truncate to acute, trigonous, brown, glossy. (Figure 7E–H).

**Taxonomic remarks.** This is an extremely variable species, with a number of forms sometimes recognized as separate species, varieties or subspecies (see Barros 1953; Balslev 1996; Kirschner 2002). Since the regional literature recognizes the var. *achalensis* (Barros 1953; Novara 2009; Novara 2012; Zuloaga et al. 2019) we treated the northern Patagonian specimens as var. *pallescens*, however other authors do not recognize the varieties (Balslev 1996; Kirschner 2002). The thickness of the inflorescence smallest branches was proposed as a primary feature for distinguishing *J. pallescens* (>0.45 mm) from *J. microcephalus* (<0.4 mm) (Balslev 1996; Kirschner 2002). However, we



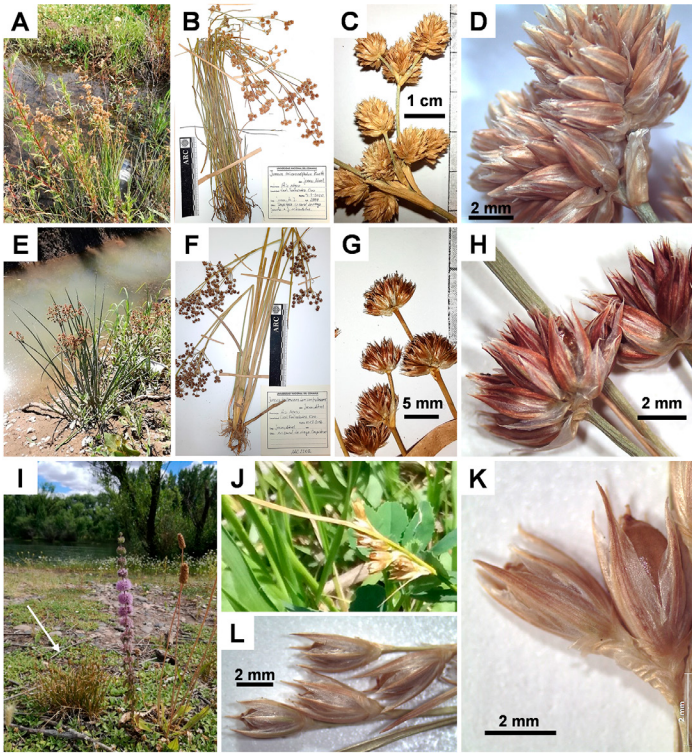


Figure 7. *Juncus microcephalus*. A. Habit, irrigation canal. B. Herbarium sheet. C. Close-up of inflorescence, dry specimen. D. Close-up of heads. *Juncus pallescens* var. *pallescens*: E. Habit, irrigation canal. F. Herbarium sheet. G. Close-up of inflorescence, dry specimen. H. Close-up of heads. *Juncus tenuis*: I. Habit, the arrow indicates the plant, growing together with *Mentha pulegium*, *Plantago lanceolata*, and *Phyla nodiflora* var. *minor* in the shore of Limay River. J. Close-up of inflorescence, in vivo. K. Close-up of perianth with capsule, dry specimen. L. Close-up of inflorescence, dry specimen. (Photographs: A.I. Jocou)

noticed that the character is variable within each specimen, and seems to be not constant between species in the northern Patagonian material.

**Ecology and occurrence.** This taxon has a wide geographical range and inhabits edges of lakes, bogs, disturbed wet sites at a variety of altitudes (Kirschner 2002). In the northern Patagonian wetlands, this taxon inhabits shores of rivers, the natural riparian lagoon Balsa Las Perlas and it grows in irrigation canals. The water is near-neutral to alkaline, sparsely to slightly saline and poor to saturated with oxygen (Table 2). The soils where this taxon grows vary from sandy to clay.

**Specimens of reference.** Prov. Neuquén: Neuquén, Laguna Río Limay, Balsa Las Perlas, 17-XI-2018, *Jocou, Minué & Gandullo 2122* (ARC). Prov. Río Negro: Mainqué, 28-XI-2018, *Jocou 2201* (ARC); General Fernández Oro, 01-XII-2018, *Jocou 2202* (ARC).

**8. *Juncus tenuis* Willd., Sp. Pl., ed. 4 [Willdenow] 2(1): 214. 1799.**

**TYPE** (lectotype designated by Balslev, *Fl. Neotrop. Monogr.* 68: 79. 1996): “America Boreali”, s.d. (B! barcode B -W 06888 -01 0, isolectotypes B! barcodes B -W 06888 -02 0; -03 0; -04 0; NY! fragment, barcode 00247725; HBG and AAU, not seen).

**Brief description.** Perennial caespitose plants, usually 15–50 cm tall. Leaves basal, flat. Inflorescence usually lax, less often in denser clusters, of 1–5 primary branches, 5–40-flowered, flowers arranged in irregular groups, bracteoles broadly ovate, membranous. Tepals lanceolate, acuminate, central band green, paler and membranous towards the margins. Stamens 6, anthers shorter than filaments. Capsule sub-trigonous, ellipsoid, subacute to obtuse, tan or light brown, shorter than perianth. (Figure 7I–L).

**Taxonomic remarks.** Although Jocou and Gandullo (2020) included var. *congestus* Engelm. in their floristic study, the examined specimens actually correspond to *J. tenuis*. In addition, the var. *congestus* is recognized today as a synonym of *J. occidentalis* (Coville) Wiegand (Kirschner 2002).

**Ecology and occurrence.** *Juncus tenuis* inhabits exposed or shaded areas, often along roads and disturbed sites in sandy to clay soils, under moist or drier conditions; wet grasslands, forests, on nitrified, and more or less compacted substrates; it is considered a weed whose distribution is influenced by human activity; from 1000–3000 m a.s.l. (Kirschner 2002; Romero Zarco 2010. Balslev and Duno de Stefano 2015). Balslev and Duno de Stefano (2015) stated that the dispersal of this species is facilitated by the ability of the seminal coating to swell and become sticky, jelly-like and sticking easily to grazing animals. In the northern Patagonian wetlands, this taxon inhabits the shores of Limay River, at an altitude much lower than reported by Balslev and Duno de Stefano (2015) for Mexico. The water is near-neutral to alkaline, sparingly saline and saturated with oxygen (Table 2). The soils where this taxon grows are mainly sandy. In the studied wetlands, it is the taxon that is most adapted to drier conditions.

**Specimen of reference.** Prov. Neuquén: Senillosa, 20-XII-2018, *Jocou, Minué & Gandullo 2241* (ARC).

#### EXCLUDED TAXA

***Juncus stipulatus*** Nees & Meyen, *Nov. Actorum Acad. Caes. Leop.-Carol. Nat. Cur.* 19 (Suppl. 1): 126. 1843.

**TYPE** (holotype): Chile, Valparaiso, Feb. 1831, *Meyen s.n.* (PR, not seen).

Although Jocou and Gandullo (2020) included this taxon in their floristic analysis, the examined specimens identified as *Juncus stipulatus* (Jocou, Minué & Gandullo 2117 ARC) correspond to depauperate and young plants of *J. articulatus* subsp. *articulatus*. Due to this, we exclude *Juncus stipulatus* from the flora of the northern Patagonian wetlands.

## CONCLUSION

Eight species and nine infraspecific taxa of *Juncus* occur in the northern Patagonian wetlands, inhabiting different water and soil conditions. *Juncus stipulatus* was previously recorded based on a misidentification and is excluded here for the northern Patagonian wetlands. A comprehensive revision of the species of *Juncus* in Argentina is needed for the clarification of both taxonomic and nomenclatural aspects within the genus.

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## REFERENCES

- Balslev, H. 1996. Juncaceae. *Flora Neotropica* 68: 1–167. <http://www.jstor.org/stable/4393863>
- Balslev, H. 2018. Two new species of *Juncus* (Juncaceae) from South America. *Phytotaxa* 375: 97–102. Doi: 10.11646/phytotaxa.376.2.3
- Balslev, H. and R. Duno de Stefano. 2015. La familia Juncaceae en México. *Acta Botanica Mexicana* 111: 61–164. Doi: 10.21829/abm111.2015.182
- Barros, M. 1945. Juncáceas argentinas. *Holmbergia* 4: 101–112.
- Barros, M. 1953. Las Juncáceas de la Argentina, Chile y Uruguay. *Darwiniana* 10: 279–460.
- Barros, M. 1969. Juncaceae. In: N.M. Correa (dir.). *Flora Patagónica, Parte II: Typhaceae a Orchidaceae (excepto Gramineae)*. INTA, Buenos Aires. pp. 109–137.
- Brooks, R.E. and S.E. Clemants. 2000. *Juncus*. In: *Flora of North America Editorial Committee* (eds.). *Flora of North America* 22. Oxford University Press, New York. pp. 211–255.
- Cope, T.A. and C.A. Stace. 1978. The *Juncus bufonius* L. aggregate in western Europe. *Watsonia* 12: 113–128.
- Fernández, C.J., A.I. Jocou, and R. Gandullo. 2018. Vegetación acuática bioindicadora de eutrofización del Alto Valle de Río Negro (Argentina). *Ernstia* 28: 45–93.
- Ferrer-Gallego, P.P. 2019. Typification of four Linnaean names in the genus *Juncus* (Juncaceae). *Taxon* 68: 142–151. Doi: 10.1002/tax.12013
- Gandullo, R. and J. Gastiazoro. 2009. Suaedetum neuquenensis nueva asociación de ambientes salinos. *Multequina* 18: 31–36.
- Gandullo, R., C. Fernández, and A.I. Jocou. 2019. Sintaxonomía de las comunidades de plantas vasculares del sistema de drenaje del Alto Valle de Río Negro, Patagonia, Argentina. *Boletín de la Sociedad Argentina de Botánica* 54: 567–587. Doi: 10.31055/1851.2372.v54.n4.24826
- Grime J.P., J.G. Hodgson, and R. Hunt. 1988. The Autecological Accounts. In: J.P. Grime, J.G. Hodgson, and R. Hunt (eds.). *Comparative Plant Ecology*. Springer, Dordrecht. pp. 53–615. Doi:10.1007/978-94-017-1094-7\_5
- Guofang, W. and S.E. Clemants. 2000. *Juncaceae*. In: Z.Y. Wu, and P.H. Raven (eds.). *Flora of China* 24. Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis. pp. 44–69.
- Jocou, A.I. and N.F. Brignone. 2020. First record of *Juncus articulatus* subsp. *articulatus* (Juncaceae) for the Southern Cone flora. *Boletín de la Sociedad Argentina de Botánica* 55: 631–640. Doi: 10.31055/1851.2372.v55.n4.29938
- Jocou, A.I. and R. Gandullo. 2020. Diversidad de plantas vasculares de los humedales de la Norpatagonia (Argentina). *Revista del Museo Argentino de Ciencias Naturales* 22: 131–154. Doi: 10.22179/REV-MACN.22.688
- Jocou, A.I., C. Fernández, and R. Gandullo. 2018. Macrófitas acuáticas vasculares del Sistema de drenaje del Alto Valle de Río Negro, Patagonia (Argentina). *Revista del Museo de La Plata* 3: 296–308. Doi: 10.24215/25456377e060
- Kirschner, J. 2002. Juncaceae 2: *Juncus* subg. *Juncus*, *Species Plantarum: Flora of the World* 7. Australian Biological Resources Study (ABRS), Canberra, Australia.
- Lozeco, C.V. 2014. Desarrollo de un esquema de gestión integrada para los colectores de drenaje de la ciudad de Cipolletti (Río Negro, Argentina). Tesis de Mestría. Universidad Nacional del Litoral. Doi: 10.29104/phi-aqualac/2015-v7-1-04
- Novara, L.J. 2009. Juncaceae. In: R. Kiesling (dir.). *Flora de San Juan, Vol. IV: Monocotiledóneas*. Zeta Editores, Mendoza. pp. 377–391.
- Novara, L.J. 2012. *Flora del Valle de Lerma: Juncaceae. Aportes Botánicos de Salta – Ser. Flora, Vol. 1 (edición digital)*. Herbario MCNS, Salta.
- Peri, G. 2004. La agricultura irrigada en Río Negro y su contribución al desarrollo regional. World Bank, Buenos Aires.
- Romero Zarco, C. 2010. *Juncus*. In: S. Talavera, M.J. Gallego, C. Romero Zarco, and A. Herrero (eds.). *Flora Iberica: Plantas vasculares de la Península Ibérica e Islas Baleares* 17. CSIC, Madrid. pp. 123–187.
- Snogerup, S. 1993. A revision of *Juncus* subgen. *Juncus* (Juncaceae). *Willdenowia* 23: 23–73.
- Thiers, B. 2021 [continuously updated]. *Index Herbariorum: a global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/science/ih>
- Zuloaga, F.O., J.M. Belgrano, and C.A. Zanotti. 2019. Actualización del Catálogo de las Plantas Vasculares del Cono Sur. *Darwiniana, nueva serie* 7: 208–278. Doi: 10.14522/darwiniana.2019.72.861